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ABSTRACT

The review of the empirical literature on simulation gaming categorizes positive, negative, and contradictory aspects of gaming as an educational tool as revealed by the research. The review, which concentrates on simulation games for elementary and secondary school students, is presented in seven sections. Section I presents a brief history of gaming. Section II assesses data in recent gaming literature on learning versus interest in role playing. The importance of background knowledge and abilities that students bring to games is discussed in section III, followed by identification of the problems and positive aspects of role playing in sections IV and V. Problem areas include lack of role involvement, boredom, and the similarity of all simulation games. Positive aspects include the changed role of the teacher, the socialization process that occurs during the game, and the ability of games to teach complex problems in the classroom. Section IV discusses computerized games, the contribution of computers to gaming, and the increased sense of efficacy experienced by students using computerized games. The last section summarizes the literature on gaming by listing the positive aspects of gaming, the major drawbacks, and the benefits which result from the new computerized games of strategy. References are included. (Author/DB)

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SIMULATION GAMING: A CRITICAL REVIEW

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SIMULATION GAMING: A CRITICAL REVIEW

Educational gaming has moved from an initial novelty stage to the point where simulation games are now purposefully included in the structural framework of most new curricula. During this developmental period some researchers have begun to measure the impact and usefulness of simulation gaming as an educational tool. This review attempts to categorize and evaluate gaming research as well as to suggest directions for productive future research. The focus is upon simulation games generally used to bolster understandings of life for elementary and secondary school students. The major distinguishing features of simulation games are: (1) the games are played over time, but time is accelerated. For example, students may relive one hundred years of history in an hour; and (2) game players need not live with the consequences of their decisions made during game play because indeed the simulation is just a game. These games are therefore different from games designed to strengthen skills. This review will not treat simulation training games such as those used in graduate business education.

Brief History

Gaming as a training device goes back to the fifteenth century Europe when chess was often used to train military officers. By the nineteenth century, the military had moved from the chess board to terrain maps, using wooden blocks instead of chessmen. By World War Two, all the powers were using war games. Germany held serious joint military and political games each year, participated in by representatives of the army, government, business, the arms industry and the propaganda ministry.

The American Management Association introduced a business game at its meeting in 1957. It was a very simple game built on the principles of the war games. Yet,

> the response by participating executives and educators was so enthusiastic that a proliferation of games appeared very quickly... Two-thirds of the graduate schools of business soon adopted the games or developed their own as part of the standard curriculum (Inbar and Stoll, 1972, p. 39).

Since that time gaming has spread into all levels of the social sciences, both as a vehicle for studying social phenomena as well as an educational tool.

Despite this rapid spread of experimental, educational and commercial games, little empirical data exists as to the effectiveness of simulation gaming as a teaching device. Further, almost all the published studies in the educational literature that report attempts at measuring the effectiveness of gaming have used role-playing games. In role-playing games the players assume roles of other people. The quality of play of these games often depends upon the ability of the players to understand their assumed roles. In recent years some non-role-playing simulation games have been developed and tested. These games focus on decision-making (or strategies) for solving problems or achieving desirable objectives. In these games the players need not assume the roles of other people.

Role-Playing Games: Learning versus Interest

Some researchers working with non-simulation, skill building games, such as Equations, have found significant increases in learning in their studies (Allen and Ross, 1974). In contrast, while simulation games usually produce increased interest and

enthusiasm for the subject studied, researchers generally agree that simulation gaming does not produce a significant increase in knowledge over other teaching methods. In 1966, Cherryholmes, reviewing six research studies, concluded,

> students report more interest in simulation activities than in more conventional classroom exercises [but] students do not learn significantly more facts or principles by participation in a simulation...activity (pp. 5-6).

That same year Robinson reported on his own experiment. He split three college-level international relations classes into two groups each. One group studied the course by the case method, the other used the Inter-Nation Simulation developed under the direction of Harold Guetzkow. Robinson found no difference in learning between the two methods; however, he found the simulation to be more interesting and more involving for the students.

Boocock (1967), reporting on an experiment for high-school students using her Life-Career Game, stressed the enthusiasm shown by the players as well as the fact that those who played the game learned what the game tried to teach. While Wing (1968), reporting on the results of an experiment involving two computer role-playing games for sixth graders, found no significant difference in knowledge gained, but found the same information could be learned by the student in about half as much time.

In 1971, Fletcher, testing two games in conjunction with the Education Development Center's "Man, a Course of Study" unit, concluded,

> The data from this study clearly indicate that the games were successful as teaching devices. The test questions measured a variety of kinds of knowledge which related to

the game experience, and on all of these kinds of questions the students did well(p. 264).

Again in 1971, Livingston attempted to demonstrate that gaming improves a student's learning of companion factual knowledge because of increased motivation. He used the game Trade and Develop as an aid in teaching economic geography to junior high school and high school students. He repeated the study three times. The experimental group played the game, followed by the experimental and control group together doing the learning exercise. His results showed no significant difference between the experimental and control groups in any one of the three studies. Livingston therefore concluded:

> The implications of these results for the use of simulation games in schools seems clear: A simulation game cannot be expected to improve students' learning of factual material or audio-visual materials. The conclusion does not follow, however, that simulation games are without educational value (p. 20).

Livingston further noted that

> the teachers who administered these experiments in their classes all reported that their students were enthusiastic about the game and seemed to be learning from it; yet these experiemnts failed to show an advantage in the tests for students who had played the game (p. 20).

In 1972, Chartier designed a study to test the hypothesis that subjects who participate in a simulation game with a discussion component will demonstrate higher learning outcomes at the cognitive and affective levels than will subjects participating in simulation without discussion, discussion without simulation, or neither (individual study) (p. 214).

Chartier tested this hypothesis by administering an achievement test following Bloom's six level cognitive taxonomy. He found no significant difference in cognitive level among the three experimental groups. However, he did find a significant increase in the affective domain and therefore concluded that

> subjects who participate in a simulation game with discussion will express more satisfaction with learning than will subjects participating in simulation without discussion, discussion without simulation, or neither (individual study) (p. 214).

Ahern, summarizing the gaming literature until 1968, could not find a quantitative study on the usefulness of gaming as a learning device. However, Ahern concludes that despite the lack of statistical evidence of effectiveness gaming has grown rapidly in popularity.

> The use of games is spreading to almost every educational area, from post graduate through grade school in education, from president through machine operator in industry, and from administrator through clerk typist in government. That gaming is enjoying this growth...is due in large measure to the "belief" in rather than "proof of" its ability and versatility to fulfill many diverse training requirements (p. 25).

Later, in 1972, Schran and Krumpf attempted to assess the state of the art in environmental gaming. They found very little published material on gaming and concluded:

> that this lack of attention to the basic underpinnings of gaming is a main reason for much of the widespread uncertainty

> and confusion found in this field by the authors and others (p. 465).

They further concluded that "the validation of the general appropriateness of gaming techniques remains on the level of subjective evaluation and thus still open to scientific proof" (p. 472).

None of these studies questioned that games do as well as other methods in achieving learning; all, however, raise doubts as to whether gaming represents a superior technique. One recent study by Wylle, however, did report a significantly better contribution to cognitive learning from gaming. Wylle's experiment involved teaching geographic knowledge and skills. He used a game called Sailing with one group of children while using programmed instruction with another group.

> The findings of this experiment indicated that, immediately after treatment, learning to answer questions related to cognition of geographic information was accomplished at least as effectively by "Sailing" as by a programed instruction approach. There was no significant difference in the mean scores between students who played the game and students who were taught by the programed text on the post-test measure of total cognition of geographic information. Two weeks after treatment, however, students who played the game scored significantly higher on the test measuring total cognition of geographic information than students taught by the program (1974, pp. 309-10).

Perhaps this finding preludes a new trend in gaming research results.

Role-Playing Games: Importance of Background Knowledge and Ability

Guetzkow (1963) and Barringer and Waley (1965), reporting on their use of college level political games (Inter-Nation Relations and the M.I.T. Political-Military Game) all found that the knowledge the student brought with him to the game was critical. Guetzkow found, "seniors with an international relations course background seemed to profit from the experience more than those without" (p. 37). While Barringer and Waley report, "in general, the insights and lessons provided by the gaming experience prove to be dependent largely upon the knowledge and preoccupations brought by the participants to the experience" (p. 445).

Bagley's research with eight year olds indicated similar conclusions. Bagley used the game Gold Miners and Merchants: A Simulation Game for his research, the purpose of which was to "determine if sex and ability were important variables in mediating learning and retention of learning from a simulation game" (1974, p. 290). Bagley concluded that ability was of primary importance while sex was not an important factor in learning resulting from game play.

Fletcher's research with the games included in the Education Development Center unit "Man, a Course of Study", was able to make a finer calibration of the influences of ability on game learning. Fletcher states that

> some kinds of learning are linked to the quality of play, while others are not. For those kinds which are not linked to quality of play the games are not effective in overcoming ability differences and teaching slow students as well as bright ones. For those kinds of learning linked to quality of play, games seem able to teach the slower student as well as the brighter. It would tentatively appear that the common claim that games can teach students who are not reached by

> ordinary instructional techniques is true only of those kinds of learning which are dependent on quality of play (1971, p. 286).

Ability, therefore, seems to be a factor of consequence in gaming research. Exactly what role ability plays in determining the usefulness of games as an educational technique is still unclear.

Role-Playing Games: Problems

The literature has pointed out three problem areas with role-playing games. First, a student must become adequately involved in the character he plays to make the game successful. Some games are structured so this effect is achieved while other games tend to be less realistic. Using the Inter-Nation Simulation, Snyder states his most meaningful observation as the

> abundant evidence that participants take simulations very seriously indeed and are capable of complete absorption, so much so that contacts among participants and thinking about simulation are extended beyond the laboratory (1963, p. 12).

Cohen, however, reports a contradictory finding. Because of the "instability and fundamental unreality of the game world's power structure [the players found it very difficult to act] even remotely as real-world politicians do in making their institutions and their political machinery work (1962, pp. 373-4).

Next, Zaltman points out, "a general problem in simulation games is that some roles...are necessary for the functioning of the game but may be boring for the players" (1972, p. 128). This comment has been made in regard to almost every role-playing game in the literature.

Finally, a third problem area in gaming is discussed by two psychologists, Breznitz and Lieblich.

> We have observed that while the phenomena which are simulated are very diverse, their simulations are surprisingly more similar. After playing four or five simulation games, one feels the difference between them blur and gradually vanish.
>
> Some of the reasons for this situation are more obvious than others. For instance, the obsession with quantification turns everything into points: status points, satisfaction points, anxiety points - or, as in our simulation, censorship points, tension points, and what-not points (1972, p. 80).

Role-Playing Games: Positive Aspects

Despite problems associated with role-playing games, a number of positive aspects result, including: the shifted role of the teacher; the socialization process that occurs during game play; and the ability of games to teach complex problems in the classroom. Charles Silberman (1970), as a result of his survey of schools across the country, has strongly recommended that the role of the teacher shift from the more traditional center spot in the classroom to that of a learning facilitator. Both Boocock and Inbar have found that this shift takes place when games are used in the classroom. For example, Inbar (1972) observed that the teacher's role changed from that of a judge to that of a coach.

Twelker made a similar observation. After reviewing the lack of conclusive research on gaming, Twelker ends his reflections by saying:

> The brightest side of simulation just might be its potential for changing, not the student, but the teacher. This writer

has seen teacher, bored and boring, become challenged with the potential of simulation. Their attitude toward students, toward school, and towards themselves change. Teachers "turned on" by simulation became instructional managers interested not only in imparting information but with creating an instructional climate that challenges the student's will to learn (1972, pp. 152-3).

Mead identified another positive aspect of games. He observed that games are a stage of development for the child. He noted that children move from play to games as they go through the process of socialization.

> The game is then an illustration of the situation out of which an organized personality arises. In so far as the child does not take the attitude of the other and allows that attitude of the other to determine the thing he is going to do with reference to a common end, he is becoming an organic member of society.
>
> The importance of the game is that it lies entirely inside of the child's own experience, and the importance of our modern type education is that it is brought as far as possible within this realm (1934, p. 154).

Not only are children socialized towards adult roles via game playing, as Mead suggests, but also games seem to bring the complex and faraway world problems to the concern and understanding of students. This has been noted by numerous researchers. Carlson finds that games "increase the confidence of young people to deal with real world problems that seem impossibly remote from their own lives" (1971, p. 338). While Inbar reports

that the

> telescoping of time and space can cause the participants in a simulation game to involve themselves deeply in situations which otherwise remain as remote from their interest as from their personal experience (1972, p. 148).

Boocock further notes, "the game appears to have special value for adolescents from culturally-deprived groups. For them the simulated environment supplies a kind of experience lacking in ther own actions" (1972, p. 184). Coleman found, "the evidence from use of games in the classroom indicates that a much broader span of ability can be usefully encompassed by simulation games" (1968, p. 71).

Farran reports that they found games so useful in their two schools for underachievers, the North Carolina Advancement School and the Pennsylvania Advancement School, that they are now designing their total curriculum around games (1967, pp. 10-11). Finally, Clark Abt, from his experience in designing educational games, states the same conclusions as Boocock, Coleman, and Farran. Abt (1968) says that games can accommodate a wide range of learning abilities and ages. Moreover, culturally deprived children respond better to games than to conventional teaching methods.

Perhaps some of the reasons for the ability of games to reach children with a variety of backgrounds can be found in the research on student attitudes. Coleman's most significant finding in his study of equality of educational opportunity in the United States was that the "pupil attitude factor which appears to have a stronger relationship to achievement than do all the 'school' factors together is the extent to which an individual feels that

he has some control over his own destiny" (1966, p. 23). Moreover, Boocock reports:

> sociological studies of political behavior have shown that the people most likely to take an active part in politics are those with strong feelings of political "potency" or efficacy - who feel that their actions (voting, working for a political party, etc.) will have a desirable effect upon their government (1968, p. 126).

Boocock goes on to speculate that a gaming experience in the classroom gives the students the confidence and the feelings of efficacy that should develop active-oriented citizens.

> A final observation about the nature of feelings of efficacy is that they can apparently occur along with a realization of the difficulties of decision-making in complex social situations... "Practicing" in a simulated environment gave some players greater confidence in their ability to control social situations, at the same time they acquired a more realistic view of what the situation was like and saw the necessity for further learning about it (1968, p. 129).

Burgess and Robinson came to the same kind of conclusion as Boocock. They state:

> the content and play of games over many years may operate to modify certain dimensions of the personality of the individual - his self-esteem, his self-confidence and feelings of efficacy, which are known to be important variables in the political behavior of the adult (1968, p. 247).

Coleman sums up several researchers' thoughts on the ability of gaming to teach the complexities of society by stating:

> schools find it difficult to teach about the complexity that characterizes modern society, with the result that students have had little or no experience to prepare them for facing a multitude of decisions and problems in adult life. The games we and others have created present the student with an approximation of certain facets of modern society that he will have to face later (1971, p. 324).

More recent studies tend to back up these observations. Livingston (1972) used the game Democracy, which focuses of the process of "log-rolling", to see if, after playing the game, the students will be more tolerant of "log-rolling", and to see if the students' feelings of political efficacy would increase. Livingston found a significant increase in tolerance for "log-rolling" in both classes playing the game. However, he found a significant increase in feelings of political efficacy in only one of the two classes.

In another recent study, Vogel attempted "to determine, by experimental means, whether differences in the method of teaching civic government have any significant effect on the change of the attitude of political efficacy" (1973, p. 71). Vogel used ten classes of sixth graders for the study. A unit on civic government was taught to half the classes using the game Metro Government while the other five classes were taught the unit without the game. Vogel reports that the attitude of political efficacy "scores of the experimental group were significantly higher than those of the control group after the unit" (p. 75).

These more current research studies are beginning to establish an empirical data base for the early instincts of the pioneers

in the gaming field.

Computerized, Non-Role-Playing Games

Non-role-playing games stress strategy. Chess is a classical non-role-playing (but also non-simulation) game. The essence of chess is figuring out the best sequence of decisions to try to generate a successful outcome. Non-role-playing games make no demand on players to internalize another's view of the world. They demand only a focus on effective problem-solving, an analytical perspective toward the game's objective.

Papert, although working in the area of mathematics, brings to focus the basic strengths hypothesized for computerized, non-role-playing games.

> One might dream of having children learn mathematics by giving them a ship to sail the ocean, a sextant to fix their position and a cargo to trade with distant peoples. A large part of our work is directed at trying to make this dream come true by creating mathematical instruments more manageable than ships and sextants, but which still allow the child to develop and exercise mathematical arts in the course of meaningful, challenging and personally motivated projects (1971, p. 3).

Ideally, children should learn about the problems of a city, a country or the world by having them involved in the real-life decisions of these areas. But this kind of learning setting is in the realm of dreams. A computer game, developed from a simulation model built to include all the variables considered important to the real-life problems, becomes a tool that is next best to the reality itself. This game then allows students to test their own

theories about solving life's problems.

Computerized games avoid problems encountered over the years with man games or man-machine games. Sanders, reviewing Inbar's non-computerized Community Response game, concludes,

> the more variables introduced, the more realistic the game is likely to be but unfortunately also the more difficult the game is to play. "Community Response" is an example in which realism is achieved at the expense of simplicity and it takes a Philadelphia lawyer a couple of days to figure out the rules. Many less complicated games seem artificial (1968, p. 163).

Ahern points out how the computer avoids this problem:

> The advent of the high speed electronic computer enormously increased the calculations which could be incorporated in a game as well as freed the participants from the stringent limitations inherent in computations made by hand on a desk calculator.
>
> The computer has further contributed to the value of gaming by providing the means whereby a great deal of realistic complexity can be incorporated into a game while keeping the administration problems relatively simple. The purpose of the game is thus maintained in that the players are allowed to concentrate on the basic goals of actual decision making, while the computer is relegated all of the clerical and mathematical tasks (1968, p. 5).

Finally, Clayton and Rosenbloom point out another strength of computerized, non-role-playing games:

> We believe that the fruitful path is to choose games which

emphasize strategy and structure, rather than personal roles. Moreover, if children play against "nature" rather than against other children, feedback can be specifiable and immediate (that is, the children compete against each other, but direct interaction is with "nature") (1968, p. 92).

A pilot studey was done with a sixth grade class in Lexington, Massachusetts, using a computerized, non-role-playing game having the characteristics described above. The game, called the World 3 Game, was adapted from the World3 simulation model developed under the leadership of Dennis Meadows (1973) at M.I.T. The model was built to better understand, from a world perspective, the relationships among population growth, food, natural resources, industrial products and pollution levels. The purpose of the study was to test the playability of the World 3 Game for a larger study. However, the results of this pilot study are worth noting.

The main focus of the World 3 Game was structure; that is, understanding the interrelationships among the variables listed above. The students acted as decision teams whose objective was to play against "nature", in the form of a computer model, to create a liveable world over the next one hundred years. The teams analyzed the situation they faced, reached their decisions, and then tested their decisions on a computerized simulation model representing the world. The results of the teams' decisions were fed back to them by the computer in graphic form.

The study hypothesized that the particular ability of role-playing games to increase the students' feelings of control over their future would be retained even though roles were being

eliminated. This sense of efficacy was measured by a pre and post-test based on Coleman's (1966) questions and Coopersmith's (1967) Self-Esteem Inventory. The pre-test was administered, and the game was started in the first class session. For the next two weeks, during a one hour session each week, the game was played. In the fourth week the final game runs were discussed by the class and the post-test was administered. A total of four hours over a four week period was spent with the class. The test scores showed a significant increase, at the .05 level, in the students' sense of control over their futures.

This small study suggests that the positive aspects of role-playing games were maintained by this computerized, non-role-playing game, while some of the negative aspects as revealed by the literature, were eliminated.

Critique

The empirical literature on educational simulation gaming, based largely on research using role-playing games, indicates a number of positive aspects of gaming:

1. Students learn at least as much at the cognitive level from games as from other methods of instruction.

2. Interest and enjoyment is higher in learning situations using games.

3. The teacher's classroom role tends to shift from a center-front focus to a learning facilitator.

4. Games provide children with opportunities to try out other roles in life and to experiment with problems they have not yet encountered. These exercises appear to give children more of a sense of control over their futures, which seems to be

a crucial factor in school success.

A contradiction brought out in the empirical studies is the claim that ability and background knowledge are important variables in successful game play while at the same time other authors claim games enable reaching children of all abilities and background.

Two major drawbacks have also been noted that are specific to role-playing games:

1. In games requiring role-playing, the players sometimes succeed in becoming absorbed in their roles and sometimes do not. When players cannot empathize with their assigned roles in the games, success is lessened. Games often have passive role requirements which players usually find boring.

2. Role-playing games tend towards similar design characteristics so that after playing several games the structural differences among them blur.

A new and potentially productive area of educational gaming is emerging that might be labelled "computerized games of strategy". The main benefits resulting from these new kinds of games are:

1. Computerized games of strategy eliminate the problems noted above as occurring in role-playing, board games.

2. Computerized games of strategy maintain the key strengths of games, especially gaming's ability to increase the students' sense of control over their future. Games seem able to create this sense of efficacy by bringing real world problems into the classroom and allowing the students the opportunities to practice making real-world decisions. The empirical research indicates a correlation between this sense of efficacy and school success.

Games, in their variety of forms, have become a standard

part of new curricula, especially in the social sciences. This critical review indicates that it is incumbent upon designers and developers of curricula using games to evaluate and build upon this underlying base of empirical findings.

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